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(54) **Elastomeric composition for providing electrical stress control.**

(57) An elastomeric composition comprising from about 2.5 to about 25 volume percent carbon black, from about 0.8 to about 7.0 volume percent of platelet-shaped conductive particles, and optionally high permittivity inorganic fillers and platelet-shaped inorganic dielectric fillers, with the balance being the compounded elastomeric component.

The composition can be formed into tubular articles which have utility in the splicing or termination of electric power cables.

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ELASTOMERIC COMPOSITION FOR PROVIDING ELECTRICAL STRESS CONTROL

Background of the Invention

The invention relates to high permittivity elastomeric compositions for favorably influencing electric fields associated with the splicing and termination of high voltage power cables. The composition comprises a non-polar polymeric base material, a substantive amount of very fine polarizable particles capable of increasing the permittivity of the composition and an effective amount of platelet-shaped conductive particles. Typically, the composition is molded or extruded in the form of tubes for ultimate use in the splicing and terminating application, and, together with the cable insulating materials which have low permittivity, act upon electrical fields in the sense of refraction.

Compositions of the general type indicated above, i.e., wherein high permittivity is sought, are known, for example, from U.S. Patent Nos. 3,258,522 and 3,287,489, along with British Patent No. 1,394,272, all of which disclose the use of carbon black in the development of high permittivity elastomeric compositions. Further, the use of ceramic or high permittivity inorganic fillers in compositions is disclosed in U.S. Patent Nos. 3,585,274; 3,673,305; 3,816,639; 3,823,334; 3,828,115; and 4,053,702. The combination of carbon black and planarly oriented conductive platelets in highly polar organic polymer bases, in the form of thin films, has been shown to provide high permittivity with high dielectric strength, as is disclosed in U.S. Patent No. 3,349,164. Other known configurations include multi-layer heat shrink products which consist of a low permittivity heat shrinkable polymeric cover which has been internally coated with an elastomeric layer which provides high permittivity principally through the incorporation of silicone carbide particles, although conducting particulate fillers may

also be included: see for example U.S. Patent No. 3,950,604. Combinations of electrically conducting and insulating flakes are also known, as is disclosed in U.S. Patent No. 4,234,439.

The usefulness of inorganic particulate materials such as barium titanate and titanium dioxide as high permittivity components for compositions having or exhibiting a refractive stress controlling action has been known for a long time, but the desirable elastomeric properties were overlooked; see for example U.S. Patent Nos. 3,673,305 and 3,823,334. In this connection, it has been found that when inorganic materials of very high permittivity are utilized, e.g., barium titanate having a permittivity of approximately 6,000 to 10,000, the permittivity of the elastomeric composition cannot be increased beyond approximately 20 if the composition is to retain the desirable elastomeric properties of the base material. In other words, in order to provide satisfactory permittivity, the proportion of inorganic material becomes so high as to preclude the manufacture of practical stress control elements having adequate elastomeric characteristics for providing gap-free contact with electric power cables.

This invention provides high permittivity stress control for high voltage power cable terminations with greatly improved impulse strength allowing the utilization of compact and more economical tubular designs. Furthermore, it provides sufficient mechanical strength and high elastic memory enabling the use of PST (pre-stretched tube, as hereinafter defined) delivery during application.

Furthermore, there are other stress controlling devices which contain materials mainly acting in a resistive manner. Such materials have the inherent disadvantage that an increase in resistivity under overload conditions may result in excessive heating and accelerated aging of the material, which can ultimately lead to electrical breakdown. Conversely, the compositions of

this invention act, together with the cable insulating materials of low permittivity, upon electrical fields in the sense of refraction.

The application of tubular high permittivity stress control elements requires less knowledge and skill than the application of other stress control devices, such as the mounting of conductive stress control cones, the wrapping of stress control tapes, the molding of flowable or shapeable masses having stress controlling properties which subsequently harden at the site of installation, etc. Tubular termination designs also provide favorable economics to both the supplier and user, as less material is utilized, ultimate diameters are smaller, and creepage lengths between conductor and ground are shortened, thereby reducing space requirements at the installation site.

Summary of the Invention

In accordance with the invention there is provided an elastomeric composition comprising from about 2.5 to about 25 volume percent carbon black, from about 0.8 to about 7.0 volume percent of platelet-shaped conductive particles, up to about 8.0 volume percent of high permittitivity inorganic fillers, up to about 12.0 volume percent of platelet-shaped inorganic dielectric fillers, with the balance of the composition comprising a compounded elastomer.

The composition can be conventionally molded or extruded into tubular articles which have utility in the splicing and termination of electric power cables.

Detailed Description of the Invention

The composition of this invention is capable of being extruded or molded into a tubular shape, and, in a preferred embodiment, can also be expanded onto a core for subsequent application.

device is typically designated a "PST", which stands for pre-stretched tube. The core can be external, i.e on the outside of the tube, or can be inside the tube, such as is taught in U.S. patent no. 3,515,798, incorporated herein by reference. Preferabley, the core is internal and is a one-piece rigid spiral core having interconnected adjacent coils in a closed helix configuration.

By utilizing this PST technique, a completely insulated termination can be applied in a one step operation. The application consists essentially of a high permittivity tube covered by an arc/track and weather resistant insulation which is applied to the prepared cable simultaneously with core removal. This can provide a completely insulated termination in which the electric field stresses are controlled effectively by the high permittivity tube through the refraction of electric flux lines at the interface between the cable insulation and high permittivity tube. Another characteristic of a PST which more directly pertains to the method in which it is applied, is cold shrink. This implicitly means that such devices may be applied to cables without the necessity of a heat source, as is conventionally used with heat shrink tubing. Rather, the characteristics of shrinking behaviour are a function of superior elastic memory characteristics of the composition.

Of course, the composition can be formulated so as to be utilized in accordance with conventional slide-on techniques.

The elastomeric composition should contain from about 2.5 to about 25% by volume carbon black. The carbon black may consist of essentially any commercial grade, from the large particulate size thermal types to the fine reinforcing furnace grades, including the materials termed conductive carbon black. A preferred carbon black, especially for PST applications, is a coarse furnace grade (i.e. having an average particle

particle diameter of from about 40 to about 1-0 nanometers), and with this material, from about 10 to about 20 volume percent of the composition is prefereed. Carbon black is necessary to achieve an effective refraction of electric flux lines in the terminating device, and yet allow maintenance of a desired level of elasticity. Typically, the larger the particle size of the carbon black and the lower the structure thereof, the greater the volume fraction thereof is necessary.

In addition to carbon black, it has been determined that from about 0.8 to about 7 percent by volume of the elastomeric composition must be comprised of platelet-shaped conductive particles, typically metallic flakes. Such flakes must be sufficiently fine to disperse readily and uniformly in the elastomeric base material and not contribute to excessive gas evolution during the vulcanization process (if such is necessary), nor detract significantly from the physical properties of the resultant elastomeric tube.

Aluminium platelets are most preferred, and other metallic particles, such as copper platelets can also be utilized. For a slide-on application, it has been found that the concentration can be from about 0.8 to about 7.0 percent by volume, while requirements for the PST range from about 0.8 to about 3.0 percent by volume, with the preferred aluminum platelets, from about 1.2 to about 1.8 percent thereof by volume are preferred.

It has been determined that the minimum amount of such platelets must be present in order to achieve desired impulse strength performance, which refers to the ability of the termination to withstand the potential damaging effects caused by lightning strike surges or other transient surges on the high voltage electrical line.

While not absolutely essential to functionality of the invention, it has been determined that the inforporation of high permittivity in organic fillers can provide desirable results in the composition. Examples of such materials include barium titanate, titanium dioxide, strontium titanate, etc. The use of such materials can provide superior permittivity stability over a range of

electrical stresses and can assist in the generation of lower electrical loss for a given permittivity level. Up to about 8.0 percent by volume of these fillers can be included, with less than about 5.0 percent being preferred.

In addition, again while not essential to functionality, the incorporation of platelet-shaped inorganic fillers having dielectric characteristics can provide an improvement in the electrical strength of the invention. For example, the use of mica having particle diameters of from about 8 to about 40 micrometers and thicknesses of from about 0.5 to about 1.0 micrometers has discernably increased the dielectric strength of the elastomer composition, which in turn relates to superior AC breakdown strength of the electrical termination. This component can be present at up to about 12 volume percent, with less than about 5 volume percent being preferred.

The balance of the composition comprises the compounded elastomeric component thereof. By the term compounded is meant normal conventional operations in which ingredients are added to provide the required processing behavior and physical properties of the elastomeric device. Processing could entail open mill or internal mixing, extrusion, steam autoclave or continuous vulcanization or molding techniques. In keeping with conventional preparation of such elastomeric materials, typical process aids, process oils, coupling agents, and vulcanizing agents (if necessary) are included in the compounded elastomeric component.

Elastomers such as silicones, styrene-butadiene rubber (SBR), polybutadiene rubber (BR), natural or synthetic polyisoprenes, EPDM and ethylene-propylene copolymers (EPM) can be utilized. For the preparation of a PST, it has been determined that only EPDM and EPM elastomers provide the necessary physical characteristics for this utility.

As aforementioned, one of the key characteristics for a termination is the impulse strength, which is tested by means of the Basic Impulse Insulation Level (BIL). BIL is defined as the shock wave (1.2 x 50 microseconds) and a minimum voltage level, depending on the cable rating, that the termination must endure without electrical flashover or breakdown. (IEEE Std. 4-1978.) The desired performance level for a 20 KV termination having a 330 millimeter cutback (i.e., the distance from the exposed conductor to the cable shield or ground potential) is as follows:

Maximum Impulse Withstand (Positive and Negative)	Greater than 150 KV
100 Percent Impulse Flashover Level (Positive and Negative)	Greater than 160 KV
Average AC Flashover	Greater than 80 KV
AC Breakdown Strength	Greater than 100 KV

The AC breakdown strength should exceed the AC flashover level by at least 20 KV for the purpose of insulation coordination of the power line and to provide a margin of safety for the terminating device.

In addition to the foregoing electrical criteria for tubular stress control termination devices, if the device is in PST form, adequate physical performance criteria thereof are as follows:

ASTM	D-412	100 Percent Modulus	Less than 300 PSI (2.07 MPa)
ASTM	D-412	Ultimate Tensile Strength	Greater than 1000 PSI (6.90 MPa)
ASTM	D-412	Ultimate Elongation	Greater than 400%
ASTM	D-624	Die C Tear Strength	Greater than 150 PLI (26.3 kN/m)
Permanent Set			Less than 30%

Permanent set is a measure of the elastic memory of a cured elastomer. In the case of a pre-stretched article, excellent elastic memory will typically allow for coverage of a broad range of cable or workpiece diameters

with a minimum number of sizes of pre-stretched articles. For adequate sealability and optimum product versatility, the permanent set should not exceed about 30 per cent. To ascertain permanent set, a sample is subjected to a preselected strain at a specified temperature for a period of time, and released, whereupon the distance (diameter, length, etc.) that is unrecovered can be measured. The conditions herein involve stretching the specimen 100 percent for 22 hours at 100°C., following which the samples are allowed to equilibrate for one hour at room temperature. The samples are then released, and after a 30 minute recovery period, are measured. The following formula is then utilized to calculate permanent set:

$$\text{Percent Permanent Set} = \frac{L_{30}-L_i}{L_s-L_i} \times 100$$

wherein L_i is the original length between benchmarks, typically one inch; L_s is the stretched length between benchmarks, e.g., at 100 percent stretch, this would be two inches; and L_{30} is the length between benchmarks after the 30 minute recovery period.

The invention will now be more specifically defined by the aid of the following non-limiting examples, wherein all parts are by weight unless otherwise specified.

Example 1

An elastomeric material was prepared by utilizing the following composition:

	Parts by Weight
Nordel 1470 (tradename for an ethylene/propylene/diene monomer rubber commercially available from DuPont	50
Nordel 1440 (tradename for an ethylene/propylene/diene monomer rubber commercially available from DuPont	50
Zinc Oxide	5.0
N754 Carbon Black (a coarse grade commercially available from Columbian Chemical)	74.1
4232 NEW CT ff Aluminum Flakes (tradename for non-leafing aluminum flakes of 25 micrometer average particle diameter (90 percent through 325 mesh) commercially available from Eckart-Werke)	8.7
Silene D (tradename for an amorphous silica from Pittsburgh Plate Glass)	15
Sunpar 2280 (tradename for a paraffinic oil commercially available from the Sun Company)	30
D-148 (tradename for a processing aid commercially available from Ventron)	2.5
SR 297 (tradename for 1,3 butylene dimethacrylate commercially available from the Sartomer Company)	5.0
Silane A-172 (tradename for a vinyl silane coupling agent commercially available from Dow Chemical)	1.0

	Parts by Weight
Vul-Cup 40KE (tradename for a difunctional peroxide commercially available from Hercules)	4.2

This provides for a concentration in percent by volume of 18.7 for carbon black and 1.5 for the aluminum flakes. (Concentration level is specified in terms of volume percentage because electrical characteristics are dependent on the spacial arrangement of filler particles.)

The composition was extruded into high permittivity tubing using a conventional cold feed extruded and vulcanized in a steam autoclave. The tubing was electrically tested using a 20 KV tubular termination design having a 330 millimeter shield cut-back (the distance from the exposed conductor to cable shield or ground potential). Such testing indicated that the tubing could withstand a maximum impulse on the positive side of 176 KV and 192 KV on the negative side; the 100 percent-impulse flashover level was 189 KV on the positive side and 204 KV on the negative side; the average AC flashover was found to be 96 KV; and the AC breakdown strength was found to be 125 KV.

As for the physical properties of the tubular sample, same exhibited a 100 percent modulus of 241 PSI; an ultimate tensile strength of 1,454 PSI; an ultimate elongation of 643 percent; a Die C tear strength of 241 PLI; the permanent set was found to be 16.4 percent; and the permittivity, i.e., specific inductance capacitance (SIC), measured in the axial direction with 60 percent radial expansion, was found to be 37.6.

Example 2

An elastomeric composition was prepared as per Example 1 using the following components:

	Parts by Weight
Nordel 1470	50
Nordel 1440	50
Zinc Oxide	5
N754 Carbon Black	73.1
4232 CT ff Aluminum Flakes	7.1
K-Fil 19 (a barium titanate from NL Industries)	39.2
Silene D	15
Sunpar 2280	30
D-148	2.5
SR 297	5
Silane A-172	1
Vul-Cup 40KE	4.2

	% by Weight	% by Volume
Carbon Black	25.9	18.0
Aluminum Flakes	2.5	1.2
Barium Titanate	13.9	3.0

	Pos.	Neg.
Maximum Impulse Withstand, KV	185	164
100% Impulse Flashover Level, KV	198	181
Average AC Flashover, KV	104	
AC Breakdown Strength, KV	145	

100% Modulus	217 PSI (1.50 MPa)
Ult. Tensile	1249 PSI (8.61 MPa)
Ult. Elongation	480%
Die C Tear	182 PLI (31.9 kN/m)
Permanent Set	15.2%
Permittivity	22.0

This example illustrates the presence of barium titanate in addition to carbon black and metallic flakes,

with maintenance of suitable electrical and physical properties.

Example 3

An elastomeric composition was prepared as per Example 1 using the following components:

	Parts by Weight
Nordel 1470	50
Nordel 1440	50
Zinc Oxide	5
N550 Carbon Black, a coarse grade commercially available from Columbian Chemical	43.7
4232 CT ff Aluminum Flakes	8.0
4X Mineralite Mica, from Thompson Hayward Chemical	20
Sunpar 2280	30
D148	2
Struktol WB16, a calcium fatty acid salt from Struktol Co.	2
SR297	5
Silane A172	1
Vul-Cup 40KE	4.4

	% by Weight	% by Volume
Carbon Black	19.8	12.0
Aluminum Flakes	3.6	1.5
Mica	9.0	3.7

	Pos.	Neg.
Maximum Impulse Withstand, KV	150	151
100% Impulse Flashover Level, KV	162	164
Average AC Flashover, KV	116	
AC Breakdown Strength, KV	160	

100% Modulus	287 PSI (1.98 MPa)
Ult. Tensile	1343 PSI (9.26 MPa)
Ult. Elongation	529%
Die C Tear	212 PLI (37.1 kN/m)
Permanent Set	23.3%
Permittivity	16.1

This example contained mica, an insulating platelet material, and satisfactory results were obtained.

Example 4

An elastomeric composition was prepared as per Example 1 using the following components:

	Parts by Weight
Nordel 1470	50
Nordel 1440	50
Zinc Oxide	5
Furnex N754	61.2
Copper Powder No. 129U, a copper flake available from Atlantic Powdered Metals	27.8
4X Mica	20
Sunpar 2280	30
D148	2
Struktol WB16	2
SR297	5
Silane A172	1
Vul-Cup 40KE	13.2

	% by Weight	% by Volume
Carbon Black	23.7	16.0
Copper Flakes	10.7	1.5
Mica	7.7	3.5

	Pos.	Neg.
Maximum Impulse Withstand, KV	206	216
100% Impulse Flashover Level, KV	218	229
Average AC Flashover, KV	85	
AC Breakdown Strength, KV	108	

100% Modulus	180 PSI (1.24 MPa)
Ult. Tensile	1268 PSI (8.74 MPa)
Ult. Elongation	684%
Die C Tear	178 PLI (31.2 kN/m)
Permanent Set	27.1%
Permittivity	24.2

The above composition utilizes copper in place of aluminum and satisfactory results are obtained.

Example 5

An elastomeric composition was prepared as per Example 1 using the following components:

	Parts by Weight
Nordel 1470	50
Nordel 1440	50
Zinc Oxide	5
Furnex N754	61.2
5-XD Powder, a leafing aluminum flake from Reynolds Aluminum Pigments	8.7
4X Mica	20
Sunpar 2280	30

	Parts by Weight
D148	2
Struktol WB16	2
SR297	5
Silane A172	1
Vul-Cup 40KE	4.4

	% by Weight	% by Volume
Carbon Black	25.6	16.0
Aluminum Flakes	3.6	1.5
Mica	8.4	3.5

	Pos.	Neg.
Maximum Impulse Withstand, KV	202	204
100% Impulse Flashover Level, KV	219	216
Average AC Flashover, KV	84	
AC Breakdown Strength, KV	120	

100% Modulus	209 PSI (1.44 MPa)
Ult. Tensile	1196 PSI (8.25 MPa)
Ult. Elongation	737%
Die C Tear	196 PLI (34.3 kN/m)
Permanent Set	24.3%
Permittivity	25.1

The above composition meets performance requirements utilizing a leafing-type aluminum platelet.

Example 6

An elastomeric composition was prepared as per Example 1 using the following components:

	Parts by Weight
Nordel 1470	50
Nordel 1440	50
Zinc Oxide	5
Furnex N754	61.2
MD 2000, non-leafing aluminum flakes of 45 micrometer average particle diameter (greater than 80 percent through 325 mesh) available from Alcan Ingot Powders	8.4
4X Mica	20
Sunpar 2280	30
D148	2
Struktol WB16	2
SR297	5
Silane A172	1
Vul-Cup 40KE	4.4

	% by Weight	% by Volume
Carbon Black	25.6	16.0
Aluminum Flakes	3.5	1.5
Mica	8.4	3.5

	Pos.	Neg.
Maximum Impulse Withstand, KV	198	164
100% Impulse Flashover Level, KV	214	178
Average AC Flashover, KV	86	
AC Breakdown Strength, KV	131	

100% Modulus	207 PSI (1.43 MPa)
Ult. Tensile	1302 PSI (8.98 MPa)
Ult. Elongation	769%
Die C Tear	190 PLI (33.3 kN/m)
Permanent Set	24.7%
Permittivity	20.8

The above composition meets requirements utilizing a larger particle size non-leafing aluminum flake.

Example 7

An elastomeric material was prepared by processing the following composition:

	Parts by Weight
Wacker 101/30, a silicone elastomer available from Wacker	100
N762 Carbon Black, a coarse grade commercially available from Columbian Chemical	30
Al 4-501, tradename for aluminum flake commercially available from Reynolds Aluminum Pigments	6.0
DiCup 40C	1.4

	% by Weight	% by Volume
Carbon Black	21.8	16.1
Aluminum Flakes	4.4	2.2

When this composition was molded into a stress relief tube and formed into a termination by overmolding same with a silicone elastomer insulator, electrical properties were satisfactory.

Example 8

An elastomeric composition was prepared by processing the following composition:

	Parts by Weight
Silastic S-2351, tradename for a silicone elastomer available from Dow Corning Corp.	100
N754 Carbon Black	32
Al 4-501	10.0
Mica	15.0
DiCup R	0.4

	% by Weight	% by Volume
Carbon Black	20.3	16.0
Aluminum Flake	6.4	3.4
Mica	9.5	5.0

When this composition was tested as per Example 7, similar results were obtained.

WHAT IS CLAIMED IS:

1. An elastomeric composition comprising from about 2.5 to about 25 volume percent carbon black, from about 0.8 to about 7.0 volume percent of platelet-shaped conductive particles, up to about 8.0 volume percent of high permittivity inorganic fillers, up to about 12.0 volume percent of platelet-shaped inorganic dielectric fillers, the balance of said composition comprising a compounded elastomer.

2. The elastomeric composition of claim 1 wherein said carbon black comprises from about 10 to about 20 volume percent thereof.

3. The elastomeric composition of claim 1 wherein said carbon black is a coarse furnace grade having an average particle diameter of from about 40 to about 100 nanometers.

4. The elastomeric composition of claim 1 wherein said dielectric filler comprises less than about 5 volume percent thereof.

5. The elastomeric composition of claim 1 wherein said dielectric filler is mica.

6. The elastomeric composition of claim 5 wherein said mica has an average particle diameter of from about 8 to about 40 micrometers and a particle thickness of from about 0.5 to about 1.0 micrometer.

7. The elastomeric composition of claim 1 wherein said compounded elastomer is selected from the group consisting of EPDM, EPM, SBR, BR, silicones and natural or synthetic polyisoprenes.

8. The elastomeric composition of claim 1 wherein said condutive particles are aluminum.

9. The elastomeric composition of claim 8 wherein said aliminum particles have an average particle diameter of about 25 micrometers.

10. An elastomeric tubular article for use in the splicing and termination of electric power cables, said article comprising a composition according to any of claims 1 to 9.

11. An article for use in the splicing and termination of electric power cables comprising an elastomeric tubular member supported in a stretched condition on an easily removable core, said tubular member comprising from about 2.5 to about 25 volume percent carbon black, from about 0.8 to about 3.0 volume percent of platelet-shaped conductive particles, up to about 8.0 volume percent of high permittivity inorganic fillers, up to about 12.0 volume percent of platelet-shaped inorganic dielectric fillers, the balance of said member comprising a compounded elastomer selected from the group consisting of EPDM and EPM.

12. The article of claim 11 wherein said carbon black is a course furnace grade having an average particle diameter of from about 40 to about 100 nanometers.

13. The article of claim 12 wherein said carbon black comprises from about 10 to about 20 volume percent thereof.

14. The article of claim 11 wherein said dielectric filler comprises less than about 5 volume percent thereof.

15. The article of claim 11 wherein said dielectric filler is mica.

16. The article of claim 15 wherein said mica has an average particle diameter of from about 5 to about 40 micrometers and a particle thickness of from about 0.5 to about 1.0 micrometer.

17. The article of claim 11 wherein said conductive particles are aluminum.

18. The article of claim 17 wherein said aluminum particles have an average diameter of about 25 micrometers.

19. The article of claim 11 wherein conductive particles are present at from about 1.2 to about 1.8 volume percent thereof.

20. The article of claim 11 wherein said core is a one-piece rigid spiral core having interconnected adjacent coils in a closed helix configuration.

European Patent Office

EUROPEAN SEARCH REPORT

0035271

EP 81 10 1515

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.)
D	US - A - 3 343 164 (G. WYATT) * Claims 1-[illegible], column 1, line 5 - column 4, line 38, examples 4,5 *	1,7	H 01 B 3/00 1/22 H 02 G 15/00
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	CH - A - 567 542 (NORSK HYDRO A/S) * Claims 1-[illegible], subclaims 4,7,8; column 2, lines 53-63 *	[illegible],5	
	--		TECHNICAL FIELDS SEARCHED (Int. Cl.)
A	US - A - 3 950 60[illegible] (R. FENNECK)		
A	US - A - 3 412 343 ([illegible]. GILLILAND)		H 01 B 3/00 1/22 H 02 G 15/00

CATEGORY OF CITED DOCUMENTS

X particularly relevant
A technological background
O non-written disclosure
P intermediate document
T theory or principle underlying the invention
E conflicting application
D document cited in the application
L citation for other reasons

&: member of the same patent family, corresponding document

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	15-06-1981	VITZTHUM